Validation and Application of an Automated Tool for the Identification and Characterization of Moisture Plumes Associated with Atmospheric Rivers

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Atmospheric rivers (ARs) are long, narrow, constantly evolving regions of intense water vapor transport within the lower atmosphere. When they make landfall, the events can be responsible for significant precipitation along the west coast of North America. Recent studies demonstrated that atmospheric rivers were an important contributor to recent major winter flooding events both in California and the Pacific Northwest, and that winter storms corresponding with atmospheric river conditions produced roughly twice as much precipitation along the west coast as all storms. To facilitate these studies, previous work defined objective characteristics for the identification of AR events in satellite-based integrated water vapor (IWV) retrievals. These techniques have been extended in the development of an automated tool to identify and characterize AR events in both satellite-derived and model fields of IWV.

In this presentation we will describe the development, validation, and initial application of the automated procedure. The technique employs basic objective criteria for the length (> 2000 km), width (< 1000 km), and IWV content (> 2 cm) of the plumes and standard image processing techniques including thresholding and skeletonization to identify the events. Extracted characteristics for the identified events include their position, width, core IWV content, orientation, lifetime, and propagation speed. The performance of the AR tool was validated over 5 cool seasons by comparing AR events identified by the tool with visually identified events from an existing landfalling AR climatology. The tool performed extremely well with a critical success index of 92.8% and a 98.1% probability of detection. Differences were largely the result of subjective decisions and trade-offs in sensitivity between missing actual events and inclusion of non-AR events. To evaluate how accurately present models reproduce the occurrence and representation of AR events, forecasts and analyses of IWV from multiple models are compared with corresponding satellite-based retrievals over several cool seasons. The automated AR detection procedure was applied to compare the representation of such characteristics as the frequency, size, position, and intensity of AR events in both the analyses and forecasts. Forecast fields were taken from several of the operational models included in the THORPEX Interactive Grand Global Ensemble (TIGGE). Results are presented as a function of forecast lead time in terms of quantities including probability of detection and false alarm rate. Finally, a real-time implementation of the automated tool is presented along with initial impressions of its utility from NWS forecast offices.